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Procedures and equipment

(50) As noted, the panel conducted the examination at the Firearms Identification Section of the Washington, D.C., Metropolitan Police Department. These facilities were conveniently located to the National Archives and the select committee's offices, and were made available by Police Chief Maurice J. Cullinane and Firearms Section Supervisor George R. Wilson.

(51) The panel members met initially on August 24, 1977, with the committee and the technical assistant from the Metropolitan Police Department's Firearms Laboratory. At that time, the following examination procedures were adopted:

(52) Each panel member would independently examine and compare under a microscope the bullet recovered from Dr. King, the cartridge case found in the rifle, the bullets and cartridges test-fired by the panel (see below) and the bullets and cartridge cases received from the FBI and listed as having been fired in the rifle.

(53) The panel would jointly conduct microscopical, chemical and visual examinations of all other evidence, as well as of the rifle, bullets and cartridges test-fired in it (see below). Each examiner would keep individual worksheets and notes.

(54) Among the specific tests to be conducted were:

(55) Comparison of the bullets test-fired by the panel from the rifle (see below), and with bullets received from the FBI and listed as having been fired from the rifle.

(56) Comparison of the cartridge case found in the rifle with cartridge cases test-fired by the panel in the rifle, and with cartridge cases received from the FBI and listed as having been fired in the rifle.

(57) Comparison of the exterior of the rifle with an impression in the surface of the windowsill.

(58) Before discussing his findings with other panel members, each examiner would submit his individual notes and worksheets and a final report to the technical assistant.

(59) On completion of the individual examinations, the panel would meet to discuss the findings of each member, reexamine the evidence as necessary, and then prepare a final, joint report, to be submitted to the select committe.

(60) Members would not be shown the results of the earlier FBI tests. The FBI reports were, however, to be reviewed by the technical assistant.

(61) After considering the results of the FBI's neutron activation analysis, the committee decided not to conduct further examinations of this type. Because the elemental composition of the five Peters cartridge box commercial-type cartridges differed, they could not be used as standards of comparison with the bullet recovered from Dr. Kings' body.

(62) As noted, the panel was to conduct visual and microscopical examinations, as necessary, on each item of evidence. A summary of general principles follows:

(63) A cartridge, or round of ammunition, consists of a cartridge case, primer, powder, and bullet. The primer contains a detonable mixture and fits into the base of the cartridge case, which contains powder. The bullet, constructed of lead or a lead core encased in a

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stronger metal jacket, fits into the mouth of the cartridge case. A bullet is fired by placing the cartridge in the chamber of the firearm. The cartridge base rests against a solid support, called a breech or bolt face. When the trigger is pulled, the firing pin strikes the primer, igniting the detonable mixture, which in turn ignites the powder in the cartridge case. The combustion propels the bullet through the barrel.

(64) The bore (inside of the barrel) of modern firearms is rifled with spiral grooves in it to give bullets fired through it a spinning motion for flight stability. The raised portions between the grooves are called lands. The number, width and direction of twist of the lands and grooves are called the class characteristics of a barrel.

(65) In addition to the class characteristics, the components of every firearm, such as the barrel, firingpin and breech face, bear distinctive microscopic characteristics. While the class characteristics are common to all firearms of a given model and manufacture, an individual firearm's microscopic characteristics differ from all other firearms, regardless of model or manufacture. These distinctive markings, usually referred to as individual identifying characteristics, are produced initially by the manufacturing tools, which change microscopically during operation and vary from one firearm to another. Further individual identifying characteristics may be produced as the firearm is used, during its disuse, and as a consequence of maintenance or the lack of it.

(66) When a firearm is discharged, the individual identifying characteristics of its barrel, as well as its class characteristics, are engraved on the bearing surface of the bullet. The individual identifying characteristics of the firingpin and breech or bolt face are impressed on the base or primer of the cartridge case at the time of firing.

(67) Using a comparison miscroscope, an expert can compare the markings with those produced on a similar cartridge test-fired in the same firearm. If the patterns of the microscopic markings are sufficiently similar, it can be concluded that both cartridge cases were fired in the same firearm.

(68) Microscopical examination of other firearm components and the markings they produce may also demonstrate such things as whether a cartridge was ever loaded into a particular firearm or was loaded into a firearm more than once. It is also possible, through comparative miscroscopical examinations, to determine whether two bullets were fired from the same firearm.

(69) The committee obtained the firearms evidence from the Criminal Court of Shelby County, Tenn., on March 11, 1977; the autopsy photographs came from the office of the Shelby County medical examiner. All items of evidence were inventoried before and after being transferred to and from the police laboratory in Washington in August and September. Deputy Clerk of the Criminal Court of Shelby County, Charles Koster, came to Washington on August 24, 1977, to oversee the transfer of the firearms evidence to the police laboratory and to review security precautions generally. The evidence was secured in a safe in the laboratory; a log was maintained to record when the evidence was removed for examination.

(70) The bullets and cartridge cases test-fired by the FBI from the rifle were obtained for the committee from Special Agent Cort-

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landt Cunningham, Chief of the FBI Firearms Identification Unit, by George R. Wilson.

(71) The examinations were conducted August 24 to 27 and September 23 to 27, 1978. The following equipment was used:

(72) Two American Optical forensic comparison microscopes, model K1453, serial Nos. 328 and 277, with fluorescent and incandescent lighting, fiber optics, photographic unit, and 10X eyepieces and objectives. One had a combined magnification of 12X, 20X, and 40X, the other of 20X, 40X, and 80X.

(73) American Optical low-power binocular microscope with zoom lens of 0.7- to 3-power eyepieces.

(74) EPOI "Electromike" measuring projector, model MP6.
(75) Mico model 5100 balance, with a 1,000-grain capacity.
(76) Slocomb "Speedmike" direct readout micrometer.
(77) Brown and Sharpe stage micrometer for air gap measuring.
(78) Marshall's reagent (Griess test).
(79) Sodium rhodizonate reagent.
(80) Horizontal water recovery tank.
(81) Horizontal cotton waste recovery box.

(82) .30-06 Springfield caliber, 150-grain, soft-point, jacketed cartridges of Remington-Peters manufacture, index 3033. Those cartridges test fired by the panel were designated panel T-1 to T-12. No designation was made for the unfired cartridges which the panel loaded and unloaded in the rifle.

(83) This ammunition was supplied from the police department's stock. It was similar to the expended cartridge case found in the Q-2 rifle and to the five commercial-type cartridges found in the Peters cartridge box.

(84) The panel conducted 12 test firings of the rifle using the .30-06 Springfield caliber cartridges. The first test shots were fired into a water recovery tank. This resulted in excessive expansion of the bullets' nose portion. Subsequent shots were fired into a horizontal cotton waste recovery box, which left the bullets more intact. All test-fired bullets and cartridge cases were used for comparison.

(85) Additional .30-06 Springfield caliber cartridges were used, unfired, for loading and unloading in the rifle to obtain class and individual identifying characteristics produced in that process.

(86) At the time of the panel's examination, the telescopic sight mounted on the rifle was set at "3X." An FBI report dated April 17, 1968, noted that the sight was set at "6½X" when the laboratory received the rifle the day after the assassination. *(13)* The laboratory had test fired the rifle, as received, on April 5, 1968, to determine its accuracy using the sight. Groups of three shots were fired at 205 feet, the distance from which Dr. King was believed to have been shot. According to its report dated April 14, 1968, "the center of the groups was approximately 3 inches to the right and only slightly below the line of aim." *(14)* The report noted that the sight could have become misaligned when the rifle was abandoned or during subsequent handling before the FBI laboratory received it, and that this could have caused the distortion found in the tests. For this reason, the panel decided not to test the rifle for accuracy using the telescopic sight.

(87) The panel's examination required a total of 257 man-hours. The panel submitted a final joint report of its findings on October 28, 1977.

Evidence examined

(88) The evidence examined was:

(89) Exhibit Q1 [1]—One two-piece gold, brown, and black box, labeled "Browning Mauser," found along with other evidence at Canipe's Amusement Co.[2] (See figure 1.)

(92) Exhibit Q2—One .30–06 Springfield caliber pump-action rifle, Remington Gamemaster model 760, serial No. 461476, found at Canipe's Amusement Co. Attached is a Redfield 2X to 7X variable telescopic sight, serial No. A17350, and a Weaver sight mount.[3] (See figs. 2A and 2B.)

(96) *Exhibit Q3.*—One expended commercial-type .30–06 Springfield caliber cartridge case of Remington-Peters manufacture, found in the Q2 rifle. (See figs. 3A and 3B.)

(97) *Exhibit Q4–Q12.*—Q4–Q8—Component parts of the five commercial-type .30–06 Springfield caliber cartridges of Remington-Peters manufacture, with 150-grain, jacketed, pointed soft-point bullets, found at Canipe's Amusement Co. in the Peters cartridge box. (See fig. 4A.) Q9–Q12—Four military-type .30–06 Springfield caliber cartridges of Remington Arms Co. manufacture, with full metal-jacketed bullets, found at Canipes Amusement Co. in the Peters cartridge box. (See figs. 4B and 4C. Cartridge box—One Peters .30–06 Springfield caliber cartridge box, found at Canipes Amusement Co. (See fig. 4 n.)

(98) *Exhibit Q64.*—Three fragments [4] from the damaged jacketed bullet removed from Dr. King. They were: (1) the base portion of the bullet jacket, weighing 30.9 grains; (2) a jacket fragment weighing 6.7 grains; (3) a portion of the lead core material, weighing 26.8 grains. The combined total weight was 64.4 grains. (See fig. 5.)

(99) *Exhibit Q71.*—A piece of wooden board with a tag marked, "part of windowsill from window of bathroom on east side of apartment house, second floor (north wing), over 418–422½ South Main Street, Memphis, Tenn." It was about 31⅝ inches long, 5 inches wide and 1 inch thick, highly weathered, with a considerable quantity of white paint on one edge. It had a shallow, elongated indentation about

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[1] The "Q" numbers were designated by the FBI.

[2] The panel found it to be in poor condition, held together with masking, transparent, and orange tape. It was wrapped in white twine, with a tag marked "James Earl Ray State No. 3035 and 3487." This box was originally intended as a shipping container for a Browning brand rifle.

[3] The panel found the rifle to be in good operating condition. The trigger pull was measured at 4¾ pounds, well within the manufacturer's specifications of 3½ to 6½ pounds. The magazine was a detachable box-type with a four-cartridge capacity. The barrel was rifled with six lands and six grooves, right twist.

An examination of the rifle barrel revealed a residue in the bore which the panel believed should be removed prior to test firing. This was done with a dry cloth patch pushed through the barrel.

A red-colored substance was found on the front of and inside the magazine where the operating rod screws into the receiver. Pursuant to the panel's request, the Remington Arms Co. identified it for the record as most probably "Loktite," a red-colored cement used by the Remington Arms Co. to secure certain threaded connections. (*15*)

[4] The bullet was recovered intact from Dr. King's body. As a result of subsequent handling, the bullet has since fragmented into three pieces.

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(102) *Exhibit Q77.*—One
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(103) *Exhibit Q78.*—One
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five-sixteenths inch long on the top surface midway along its length and 4 inches from the painted edge. (See figs. 6A and 6B.)

(101) *Exhibit Q76.*—One white, men's long-sleeved button-down shirt by Arrow and a pill box containing a small piece of cloth removed from the shirt by the FBI for analysis. (See figs. 7A and 7B.)

(102) *Exhibit Q77.*—One gold, brown and black necktie by Superlaine and a pill box containing two small pieces of cloth removed from the tie by the FBI for analysis. (See fig. 8.)

(103) *Exhibit Q78.*—One ~~black~~ suit coat by Petrocelli and a pill box containing a small piece of cloth removed from the coat by the FBI for analysis. (See fig. 9.)

(104) *FBI laboratory test-fired cartridges.*—Four deformed commercial-type .30-06 Springfield caliber jacketed softpoint bullets of Remington-Peters manufacture and two .30-06 Springfield caliber cartridge cases, all fired in the rifle by the FBI.

(105) *Autopsy photographs.*—Autopsy photographs of Dr. King.

FINDINGS AND CONCLUSIONS OF THE FIREARMS PANEL

(106) The findings and conclusions were prepared by staff of the House Select Committee on Assassinations based on material submitted by the panel members. The panel has read and accepts those findings and conclusions.

Was the Q64 bullet fired from the Q2 rifle?

(107) The Q64 bullet had been substantially distorted and generally damaged because of impact and penetration into Dr. King. Wiping effects from penetration were also noted. (See fig. 10.) Of the three Q64 bullet fragments (fig. 5), the panel found that only the base portion of the jacket showed class characteristics, which consisted of six grooves and six lands, right twist.

(108) Each panel member made a total of 81 comparisons between the Q64 bullet, the four bullets previously test-fired by the FBI, and the 12 bullets test-fired by the panel in the Q2 rifle. With respect to class characteristics, all members found correspondence among all bullets. (See fig. 11.) On the other hand, with respect to individual identifying characteristics, no significant correspondence was found between the Q64 bullet and the test bullets; conversely, no gross differences were found. The panel was unable positively to identify or eliminate the Q64 bullet as having been fired from the Q2 rifle.

(109) The panel noted that it is not unusual that a bullet cannot be positively identified with a particular rifle. This can result from one or more factors:

—Damage to the bullet;
—Variations in the hardness of the bullet's metal;
—Variations in gas pressures created during firing from one cartridge to another;
—Natural variations caused by the intense heat and friction resulting from the high velocity of the bullet as it is driven through the barrel.

not also rifle barrel?

(110) When the bullets test-fired by the FBI and the panel in the Q2 rifle were compared microscopically, the panel found so much variation among the individual identifying characteristics that most could not be identified with each other.

(111) The panel concluded that the Q2 rifle inconsistently engraves individual identifying characteristics on successively fired bullets.

Was the Q3 cartridge case fired in the Q2 rifle?

(112) The Q3 expended cartridge case was compared microscopically with the two cartridge cases test-fired by the FBI and the 12 cartridge cases test-fired by the panel. The panel found correspondence among the individual identifying characteristics produced by the firing pin and bolt face. (See figs. 12 (bolt face and extractor of the Q2 rifle), 13 (bolt face impressions), 14 (extractor impressions), 15 (chamber impressions), 16 (bolt locking lugs of the Q2 rifle), and 17 (bolt locking lug impressions)). The panel concluded that the Q3 cartridge case was fired in the Q2 rifle.

Was the Q3 cartridge case loaded into the Q2 rifle through the magazine or directly into the chamber?

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(113) The panel identified bolt drag marks (longitudinal striations) on the Q3 cartridge case (see fig. 17), similar to those produced experimentally on the test-fired cartridge cases and unfired cartridges. The relative position of bolt drag marks to the extractor marks (see fig. 12) on the rim of the Q3 cartridge case, which were engraved by the extractor and the bolt locking lugs (fig. 16) of the Q2 rifle, was also similar.

Is the Q3 cartridge case the same type and brand as the cases of the Q4–Q8 or the Q9–Q12 cartridges?

(114) The headstamp on the base of the Q3 cartridge case ("R–P .30–06 SPRG" (see fig. 3B)) indicated to the panel that it is commercial-type Remington-Peters ammunition—the same as the Q4–Q8 cartridges (see fig. 4A). The headstamps on the Q9–Q12 cartridges ("R A 55" (see fig. 4C)) indicated to the panel that they were military-type Remington Arms ammunition, unlike the Q3 and Q4–Q8 cartridges.

Is the Q64 bullet the same type and brand as the bullet portion of the Q4–Q8 or the Q9–Q12 cartridges?

(115) The Q64 bullet and the bullet components of the Q4–Q12 cartridges are all .30 caliber. Examination of the bullet jacket and core material of the Q64 bullet revealed that the jacket was of the same design and caliber and had cannelures similar to those of the bullet components of the Q4–Q8 cartridges (fig. 4A). The Q64 and the Q4–Q8 bullet components are therefore the same type.

(116) There were differences in design between the Q64 and the full metal-jacketed bullets loaded into the Q9–Q12 cartridges (fig. 4B). The Q64 bullet is not the same type of bullet as those in the Q9–Q12 cartridges.

Are the Q64 bullet and the Q3 cartridge case components of the same cartridge?

(117) The panel concluded that the Q3 cartridge case and the Q64 bullet had the same physical characteristics as the case and bullet components of the Q4–Q8 cartridges and that Q64 and Q3 could therefore be components of the same cartridge. However, the panel noted that there is no scientific procedure available that allows a fired bullet to be related conclusively to an expended cartridge case.

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(119) The panel did find
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Were any of the Q4–Q12 cartridges ever loaded into the chamber or magazine of the Q2 rifle or any other firearm?

(118) Visual and microscopical examination of the cartridges by the panel revealed no extractor, ejector or other marks to indicate that they were ever loaded in the magazine or chamber of the Q2 rifle or any other firearm.

(119) The panel did find marks within the extractor grooves of the Q4–Q8 cartridges similar to those made by an inertia-type bullet puller. Because the cartridges were originally recovered intact, the panel assumed that the FBI laboratory had taken the cartridges apart for its examinations.

(120) The panel found a series of marks and striations in the extractor grooves, on the sides and across the bases of the Q9–Q12 cartridges that differed significantly from the marks and striations that the Q2 rifle leaves. The panel concluded that these cartridges once were part of a disintegrating machinegun link belt or were contained in an eight-round clip of the type used with the Garand M1 rifle. (See fig. 18.)

Did the Q2 rifle cause the indentation on the surface of the Q71 windowsill?

(121) The windowsill board was examined visually, microscopically and chemically. The sodium rhodizonate test for lead, conducted at a point on Q71 removed from the impression area, was positive, indicating possible contamination from lead in the paint. The Griess test for nitrites from gunpowder residues yielded negative results. The panel decided that nothing of significant value would be obtained by further testing.

(122) Evidence of class characteristics (size and form) which could indicate the type of object making the indentation were likewise not found.

(123) The panel concluded that class and other characteristics were insufficient either for identifying or eliminating the Q2 rifle with respect to the identation. (See figs. 6A and 6B.)

Was the damage to Dr. King's Q76 shirt, Q77 necktie and Q78 suit coat produced by a bullet, bullet fragments or something else?

(124) The Q76 shirt was visually, microscopically and chemically examined (figs. 7A and 7B). It has been cut across the left and right front and on both sleeves. A small rectangular bit of material had been removed from the back collar area, as well as two small rectangular bits of material from the left cuff area. The collar button and part of the right collar stay were missing. The shirt was extensively bloodstained.

(125) The shirt had a large, elongated hole of irregular shape in the right point area of the collar, extending below the collar line. Visual and microscopical examination revealed no partially burned or unburned gunpowder in this area. The Griess test for nitrites indicated no gunpowder residue. The sodium rhodizonate test for lead showed lead particles at the perimeter of the hole in the right collar area.

(126) The Q77 tie was visually, microscopically and chemically examined (fig. 8). It was completely severed next to the right side of the

knot. A small bit of material had been cut from the rear of the neck band and two small bits from the inside lining.

(127) Visual and microscopical examination revealed no unburned or partially burned gunpowder particles in the severed area. The Griess test for nitrites was negative. The sodium rhodizonate test for lead was positive on the light-colored strand of lining protruding from the severed edge of the tie.

(128) The Q78 suit coat was visually, microscopically and chemically examined (fig. 9). It had been cut on the right sleeve and across the right chest. Small bits of material had been cut from the right upper sleeve area and the inner lining. The coat was extensively bloodstained. The upper right lapel area shows a series of irregular, tear-like holes in the outer layer of cloth. No penetration of the interfacing of the lapel was noted.

(129) Visual and microscopical examination revealed no unburned or partially burned gunpowder particles. The Griess test for nitrites was negative. Sodium rhodizonate testing revealed several areas with lead particles around the damaged right lapel area.

(130) Based on the visual, microscopical and chemical examinations of the clothing, the examination of the autopsy photographs of Dr. King, and considering the relative position of the garments when worn in the usual manner, the panel concluded that all damage to the Q76 shirt, Q77 necktie and Q78 jacket was consistent with the damage that would be caused by a high velocity bullet which fragmented on impact, and by the resultant secondary missiles such as bone and teeth fragments. The absence of gunpowder residues indicates that a firearm was not discharged in close proximity to the garments.

Summary of the findings

(131) Every effort was made by the firearms panel to identify or eliminate the Q64 bullet as having been fired from the Q2 rifle. The panel conducted numerous microscopical comparisons among bullets test-fired from the Q2 rifle by the panel and by the FBI. Not only could the Q64 bullet not be identified or eliminated through comparisons with test-fired bullets, but the test-fired bullets could not, in a majority of cases, be identified with one another, although they are known to have been fired from the same rifle.

(132) The panel found that the Q2 rifle, when the type of high velocity ammunition that was recovered in this case was used, did not produce similar individual identifying characteristics with any degree of consistency on bullets fired through it. Because of this situation, the panel could not identify or eliminate the Q64 bullet as having been fired from the Q2 rifle.

(133) The panel was able to determine, based on visual and microscopical examination, that the Q64 bullet is of the same type as the bullet portions of the Q4–Q8 cartridges. Thus, Q64 is the deformed bullet portion of a commercial-type .30–06 Springfield caliber cartridge of Remington-Peters manufacture and is unlike the bullet portions of the Q9–Q12 Remington Arms cartridges, which are military-type.

(134) The panel determined that the Q3 cartridge case was fired in the Q2 rifle and had most probably been loaded into that rifle through the magazine rather than directly into the chamber. Further, the Q4–

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The Q9–Q12 cartridges do
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(135) The panel finds th
the Q4–Q8 cartridges are
would normally be contai
There is, however, no meth
cartridge case and the Q64
in the same box as the Q4–
(136) Spectrographic an
of the Q64 bullet and the b
ducted for purposes of el
cause of variation among t
(137) The panel found th
the Q77 necktie and the Q7
by a high-velocity bullet f
secondary missiles such as b
revealed particles of lead t
ing, but no gunpowder resi
(138) The panel found
pression area of the Q71
eliminate the Q2 rifle as ha
the presence of lead was
were negated by the lead-b
analysis for the presence o
negative results. The panel
the possibility that a rifle
windowsill.
(139) The results of the
Q76–Q78 clothing and the
those of the FBI. There is
performed any chemical an

of the neck

no unburned
d area. The
onate test for
truding from

nd chemically
nd across the
e right upper
bloodstained.
ear like holes
facing of the

o unburned or
r nitrites was
reas with lead

examinations
graphs of Dr.
nts when worn
ge to the Q76
e damage that
ted on impact,
nd teeth frag-
a firearm was

to identify or
Q2 rifle. The
among bullets
FBI. Not only
ough compari-
ld not, in a ma-
they are known

e of high veloc-
d, did not pro-
h any degree of
s situation, the
as having been

sual and micro-
me type as the
s the deformed
eld caliber car-
e the bullet por-
ch are military-

ase was fired in
hat rifle through
Further, the Q4–

Q12 cartridges possess no marks indicating that they had ever been loaded into the magazine of, or chambered in, the Q2 rifle or any rifle. The Q9–Q12 cartridges do possess marks indicating that they may have been loaded into disintegrating-type machinegun link belts or an eight-round clip for the M1 Garand rifle.

(135) The panel finds that the Q64 bullet, the Q3 cartridge case and the Q4–Q8 cartridges are consistent in type with ammunition which would normally be contained in the 20-round Peters cartridge box. There is, however, no method of conclusively determining whether the cartridge case and the Q64 bullet were packaged by the manufacturer in the same box as the Q4–Q8 cartridges.

(136) Spectrographic and neutron activation analysis by the FBI of the Q64 bullet and the bullet portions of the Q4–Q8 cartridges conducted for purposes of elemental comparison, were inconclusive because of variation among the bullet portions of the Q4–Q8 cartridges.

(137) The panel found that the damage to the collar of the Q76 shirt, the Q77 necktie and the Q78 jacket is consistent with the damage caused by a high-velocity bullet fragmentation on impact and the resulting secondary missiles such as bone and teeth fragments. Chemical analysis revealed particles of lead throughout the damaged area of the clothing, but no gunpowder residue.

(138) The panel found no characteristic markings within the impression area of the Q71 windowsill which would either identify or eliminate the Q2 rifle as having been the cause. Chemical analysis for the presence of lead was performed on the windowsill, but the tests were negated by the lead-based paint in the impression area. Chemical analysis for the presence of gunpowder residue was performed, with negative results. The panel noted that these findings did not eliminate the possibility that a rifle was discharged at a point above or nearby windowsill.

(139) The results of the panel's microscopical examination of the Q76–Q78 clothing and the Q71 windowsill essentially correspond with those of the FBI. There is, however, no indication that the FBI had performed any chemical analysis of the Q71 windowsill.